

Appendix B

CRT Manufacture

Process step	Equipment	Process Material/Chemical	Notes
Fabricate glass			
Mix batch			
Melt			
Fine			
Condition			
Form panel			
Anneal			
Finish			
Clean			
Cut			
Grind and polish			
Inspect			
Test			
Pattern panel glass			
Clean			
Etch		acid	
Apply (contrast) grille material	spin coat	aquadag (polyvinyl alcohol)	1
Dry aquadag			
Apply green phosphor slurry	spin coat	slurry mixture: water, wetting agents, polyvinyl alcohol	
Dry phosphor	IR lamp		
Expose green phosphor	near-UV lamps		
Develop		water	
Dry			
Apply blue phosphor slurry	spin coat	ZnS:Ag	
Expose blue phosphor	near-UV lamps		
Develop		water	
Dry			
Apply red phosphor slurry	spin coat	Y ₂ O ₃ S:Cu	
Expose red phosphor	near-UV lamps		
Develop		water	
Dry			
Apply lacquer leveling film	spin coat or spray	polymer	
Apply reflective layer	evaporate	aluminum	1000 angstroms

Process step	Equipment	Process Material/Chemical	Notes
Prepare funnel			
Coat inside of funnel (dag)	sponge, flow coat, or spray	aquadag	2
Dry coating	evap oven		
Apply frit		Pb glass frit (PbO, ZnO, BO), nitrocellulose binder, amyl acetate	
Harden	evap oven	remove amyl acetate	
Manufacture shadow mask			
Etch hole pattern		rolled iron or Invar metal etchant: ferric chloride solution	
Clean		water	
Anneal			
Draw to face plate contour			
Blacken mask and side pieces			
Weld side pieces			
Anneal magnetic shield	oven		
Blacken shield	oven		
Manufacture electron gun			
Hydrogen fire metals			3
Fixture metal parts			
Heat glass pillars			4
Press pillars over tabs on electrode			
Mount to glass stem			
Join stem to neck	melt		
Insert cathodes into support pins			
Insert heater			
Manufacture electron gun			
Weld assembly to support pins			
Weld ribbon conductors			
Weld centering springs, getter			
Add additional parts			5
Assemble mask to panel			
Coat shadow mask back side		aluminum-killed steel bismuth oxide	
Curve shadow mask	hydraulic press		
Weld springs (brackets) to frame			
Weld mask			
Position shield on brackets			

Process step	Equipment	Process Material/Chemical	Notes
Join bulb and gun			
Attach panel to funnel	clips		total layer <.002 inch
Cure frit			> 440 °C
Seal gun to bulb			fuse base to funnel neck
Exhaust/finish assembly			
Cut excess neck glass			
Evacuate	vacuum exhaust		6
Heat tube			350 °C
Notes:			
(1) Electrically conductive carbon materials (graphite) w/silicate binders in water suspension.			
(2) Aquadag with addition of electrical conductivity modifiers, higher concentration of silicate binder, and possibly iron.			
(3) 300/400 series steels (contain Fe, Ni, Cr); borosilicate glass insulation; Ni cathode; mix. of Ba, Sr, Ca carbonates emitter material; W wire heater coated with Al oxide.			
(4) Glass pillars heated to softening temperatures.			
(5) Arcing wires, magnet pole pieces, magnetic shunts.			
(6) Excess neck glass is reused by glass companies.			